**3GPP TSG-RAN WG2 Meeting #123R2-230xxxx**

**Toulouse, France, August 21-25, 2023**

**Agenda item:** 7.2.4

**Source:** CATT

**Title:** [Post122][401][POS] SRS configuration and activation in LPHAP (CATT)

**Document for:** Discussion and Agreement

# 1 Introduction

This is to discuss the SRS configuration and activation/deactivation functionality.

* [Post122][401][POS] SRS configuration and activation in LPHAP (CATT)

 Scope: Discuss the SRS configuration and activation/deactivation functionality, including:

* determining if there are separate messages, the conditions under which they are used, and if all messages can use the same signalling method;
* evaluating the signalling options (RRC and MAC CE); and
* understanding if there is interest in pursuing the option of using a dedicated preamble.

 Intended outcome: Report to next meeting

 Deadline: Thursday 2023-08-10 1000 UTC

Rapporteur would like to have the following schedule for this email discussion.

* Phase 1: Companies are invited to provide inputs and comments to questions by 2023-08-04 18:00 UTC
* Phase 2: Rapporteur will provide draft summary with proposals, companies are invited to provide comments to the summary proposals by 2023-08-1010:00 UTC.

The purpose is to collect the views and identify the commonalties and differences in order to provide proposals for next meeting, i.e. RAN2#123.

# 2 Organization of the discussion

Firstly, the rapporteur would like to clarify there are two mechanisms on enhanced SRS configuration according to the WID and previous contributions by companies.

* Configured UE-specific SRS with validity area via RRC signalling;
* Preconfigured SRSs (with/without validity area).

In RAN2#122, the issue of “SRS configuration request” and “SRS activation request” has been discussed online. It is observed that, some companies’ views on related issues may be confused between these two enhanced mechanisms. Hence, the rapporteur would like to organize the discussion on these two enhanced mechanisms separately.

***Related agreements***

* For UE-specific SRS with validity area, the agreements on SRS configuration request were achieved.

RAN2#121 Agreements:

RAN2 assume when the UE reselects out of the positioning validity area during SRS transmission, the UE may send an RRC message to the network for SRS configuration request.

LS to RAN3 to confirm this.

RAN2#121-bis Agreement:

SRS configuration request can be indicated via Msg3/MsgA transmission. FFS if the request is in the RRC message or an accompanying MAC CE.

* For preconfigured SRSs, the agreement on activation was achieved.

RAN2#122 Agreement:

RAN2 will introduce an activation indication and/or request for preconfigured SRS using at least Msg3/MsgA; FFS if Msg1 would be supported also. FFS RRC signalling or MAC CE for the Msg3/MsgA case, as for the configuration request. This agreement does not imply that the UE will be allowed to transmit autonomously.

***Organization of this email discussion***

The remainder of this document is organized as the following. Section 3 is the questionnaire on the UE-specific SRS with validity area, containing SRS configuration request and SRS activation/deactivation. Section 4 is the questionnaire on the preconfigured SRS, contains activation indication and/or request for preconfigured SRS.

# 3 Configured UE-specific SRS with validity area

In RAN2#121-bis, it has been agreed that, RRCRelease message can be used to provide SRS configuration with validity area for UE in RRC\_INACTIVE. The SRS configuration is UE-specific within the validity area, and there will be no resource conflict problems.

## 3.1 SRS configuration request

For UE-specific SRS with validity area, it has been agreed that UE can request SRS configuration via Msg3/MsgA. Companies are invited to further discuss the detailed solution on how to request SRS configuration using Msg3/MsgA.

**Q1: For the mechanism of Configured UE-specific SRS with validity area, please provide your view on which message is used to send the SRS configuration request via Msg3/MsgA.**

* **Alt1: RRCResumeRequest**
* **Alt2: new RRC message**
* **Other**

**For the supported message, which** **following signalling method of sending the SRS configuration request do you support? Please also provide the detailed content/information of SRS configuration request in the comments column.**

* **Option A: In the RRC message, e.g. define a new resume cause in *RRCResumeRequest***
* **Option B: Accompanying MAC CE.**

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| **Company** | **Supported message (Alt1/Alt2/other)** | **Signalling method (Option A/B)** | **Comments** |
| Samsung | Alt1 | Option A | In our view, 1 bit indication in RRC message is enough for the SRS configuration request. A new ResumeCause value (e.g., SRS-ConfigRequest) can be introduced for it. (We still have 5 remaining spare bits in ResumeCause.) |
| OPPO | Alt1 | Option A | Anyway, the UE needs to perform transmission of the RRCResumeRequest towards the network when sending the SRS configuration request, so the most efficient way is to include the request in the msg3 |
| vivo | Alt1 | Option A | Alt1 with Option A is the simplest from the signalling overhead and complexity perspective.Besides, UE can update the TA by initiating the RRCResumeRequest message with the new cause value, when the UE is still within the valid area but the area-specific timer gets invalid. |
| Xiaomi | Alt 1 | Option A | Since the SRS configuration with validity area is for RRC INACTIVE UE, the RRCResumeRequest message is the straightforward way.  |
| ZTE | Alt 1 | Option A | The SRS configuration does not need to contain extra information but to request NW to configure a new SRS configuration to the UE. So a 1 bit new resume cause is enough |
| Huawei, HiSilicon | Alt1 | Option A | The scenario for LPHAP is positioning in RRC\_INACTIVE state. Therefore, Msg3/MsgA include *RRCResumeRequest*. This question is actually related to the issue of multiple pre-configured validity area. We don’t think there is a need to support multiple pre-configured validity area for the same cell. Thus, if there is only a single pre-configured validity area for a certain cell, the SRS configuration is not ambiguous without sending an index from the UE to the gNB. Thus, we do not see the need to use a new RRC message or an accompanying MAC CE.  |
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**Summary:**

## 3.2 SRS activation/deactivation

According to the online discussion in RAN2#122, for the UE-specific SRS with validity area, there are two main issues which are ambiguous in companies’ views.

Issue 1: Within the validity area, does the UE need to get permission for SRS transmission, e.g. via activation/deactivation procedure?

Issue 2: If the UE can send SRS without network permission, how to solve the issue of NW continuous monitoring SRS?

* ***For issue 1***
* Some companies think activation procedure is needed for the UE to get permission of transmitting SRS.
* Other companies think the UE has been allowed to transmit the SRS upon receiving the configuration and the activation procedure is not needed. The activation procedure will bring power consumption.
* Some companies think this issue depends on the SRS type. If periodic SRS is supported for SRS with validity area, activation/deactivation is not needed. But if aperiodic or semi-persistent SRS is supported, activation/deactivation is needed.

In Rel-18, we haven’t discussed which SRS type is supported for SRS with validity area. The SRS type will be taken into consideration as well.

**Q2: For UE-specific SRS with validity area, which SRS type do you support? For each supported SRS type, please provide your view on whether activation/deactivation is required when the SRS configuration is valid.**

* **Alt1: periodic SRS**
* **Alt2: semi-persistent SRS**
* **Alt3: aperiodic SRS**

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| **Company** | **Supported type for SRS with validity area (Alt1/Alt2/Alt3)** | **For each type of SRS, whether the** **activation/deactivation is required** |
| **Periodic (Yes/No)** | **semi-persistent (Yes/No)** | **Aperiodic (Yes/No)** |
| Samsung | Alt. 1/2 | No  | Yes | - |
| OPPO | Alt 1 | no | Yes.  | No. if a certain time-frequency resource is assigned for the SRS, then the UE does not need to be activated for SRS transmission, similar with the current implementation |
| vivo | Alt1 and Alt2 | No | Yes with comments.Follow R17 to support SP-SRS in RRC\_INACTIVE. The activation/deactivation MAC CE from NW to UE can be reused. | No.LPHAP is for Use case 6, i.e., periodic positioning. Therefore, aperiodic SRS is not suitable. |
| Xiaomi | Alt1 and Alt2 | No | Yes | No |
| ZTE | Alt1 and Alt2 | No | Yes | Support periodic and semi-persistent SRS. Support using the legacy MAC CE to trigger activation/deactivation of the Rel-18 SP-SRS |
| Huawei, HiSilicon | Alt1/Alt2 | No  | Yes |  |
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**Summary:**

If the activation/deactivation is required when the SRS configurations are valid mentioned in Q2, the activation procedure may include the activation indication from UE to gNB, as well as the activation command from gNB to UE which depend on the detailed solutions on different SRS types. The activation indication from UE to gNB will be discussed here according to email discussion scope. We will further discuss if and how gNB activate the SRS later.

**Q2-1: For each supported SRS type, if you think activation/deactivation is required, please provide your view on which message is used to send the SRS activation request via Msg3/MsgA.**

* **Alt1: RRCResumeRequest**
* **Alt2: new RRC message**
* **Alt3: Other**
* **Alt4: No need**

**Which following signalling method of sending the SRS activation request do you support? Please also provide the detailed content/information of SRS activation request in the comments column.**

* **Option A: In the RRC message, e.g. define a new resume cause in *RRCResumeRequest***
* **Option B: Accompanying MAC CE.**

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| **Company** | **For each type of SRS, the detailed solution on how to send the SRS activation request with validity area** | **Comments** |
| **periodic** | **semi-persistent** | **aperiodic** |
| **Supported message (Alt1/2/3/4)** | **Signalling method (Option A/B)** | **Supported message (Alt1/2/3/4)** | **Signalling method (Option A/B)** | **Supported message (Alt1/2/3/4)** | **Signalling method (Option A/B)** |
| Samsung | Alt4 | - | Alt1 | Option A | - | - | Please, see our comments to Q5/6 below. |
| OPPO | - | - | Alt1 | Option A | - | - | The SRS configuration is dedicated to the UE, so the UE only needs to simply indicate activation/deactivation of the SRS towards the network. A new resume cause in the RRCResumeRequest msg is enough. |
| vivo | Alt 4 |  | Alt 3, reuse existing activation MAC CE from NW to UE |  |  |  | If the UE needs to get the SRS transmission permission via activation request, the SRS configuration should be categorized as pre-configuration. |
| Xiaomi | Alt 4 |  | Alt 4 |  | Alt 4 |  | We think there is no need to introduce the activation/deactivation from UE to gNB for the SRS with validity area. |
| ZTE | Alt 4 |  | Alt 4 |  |  |  | For SRS within validity area, there is no need to introduce SRS activation request from UE to gNB. Only certain type of SRS (SP-SRS) may need to be activated/deactivated by DL MAC CE like legacy approach. |
| Huawei, HiSilicon | Alt 4 |  | Alt 4 |  |  |  | SRS activation request is used for preconfigured SRS according to RAN2 agreement.  |

**Summary:**

**Q2-2: For each supported SRS type, if you think activation/deactivation is required, please provide detailed solution on how to deactivate the SRS resource with validity area.**

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| **Company** | **For each type of SRS, the detailed solution on how to deactivate the SRS with validity area** |
| **periodic** | **semi-persistent** | **aperiodic** |
| Samsung | - | NW can deactivate semi-persistent SRS resource set using MAC CE as in legacy and the LMF can request the deactivation. | - |
| vivo | No need | Reuse existing deactivation MAC CE from NW to UE |  |
| ZTE | NW re-configures UE without the periodic SRS configuration | Legacy MAC CE to deactivate |  |
| Huawei, HiSilicon |  | Reuse legacy.  |  |
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**Summary:**

* ***For issue 2***
* After the network configures the SRS via RRCRelease message, if the activation/deactivation in Q2 is not needed, the network may has no idea of which cell the UE in RRC\_INACTIVE is camping on and when it will perform SRS transmission for positioning. Some companies raised the concern on continuous monitoring by the network. To avoid this issue, they think the UE need to indicate the NW that it is going to transmit SRS, e.g. via dedicate preamble.

**Q3: If the activation/deactivation in Q2 is not needed, do you agree the issue of continuous monitoring by the network needs to be solved? If yes, please provide the detailed solution in the comments column.**

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| **Company** | **Yes/No** | **Comments** |
| Samsung | See our comment | We understand the motivation of having validity area is to allow the UE to continue SRS transmission using the same SRS resources within a certain area. Once the SRS resources associated with a certain validity area are configured (for periodic type) or activated (for semi-persistent type), the UE can keep using the SRS resources without additional signalling overhead within that validity area. When the UE leaves the area or the NW releases/deactivates the SRS resources, the UE stops SRS transmission and NW can stop monitoring for the SRS resources. To prevent the blind monitoring in multiple validity areas, only one SRS configuration (associated with the current validity area) can be allowed to be included in RRCRelease message. Multiple SRS Resource Sets can be included in the single SRS configuration, but multiple SRS configurations associated with multiple validity areas should be excluded. The UE can request new SRS configuration after moving to a new validity area as discussed in Q1 above. |
| OPPO | No | After all, the R18 LPHAP enhancement aims at reducing the power consumption of the UE side. The activation/deactivation will definitely consume the UE power, which is against the LPHAP enhancement purposes. On the other hand, we think that instead of UE-initiated activation/deactivation method, network-based solution, such as letting the LMF notifying of the gNBs in the validity area to start to monitor the SRS when the UE is entering into the configured validity area could be pursued and is more power-efficient from the perspective of UE. |
| vivo | No | Agree with OPPO that the intention is not in the scope of WID* + For UL and DL+UL positioning for UEs in RRC\_INACTIVE state, specify SRS configuration enhancements based on SRS positioning validity area to avoid frequent RRC connection for SRS (re)configuration [RAN2, RAN1, RAN3].

The validity area is introduced to enable SRS transmission across different cells and the network does not need to know which cell the UE in RRC\_INACTIVE is camping on. |
| Xiaomi | No | We are not clear why the network need to monitor the SRS continuously. In our understanding, the network measure the SRS based on the LMF request and LMF also can indicate the network to stop measuring the SRS. |
| ZTE | No | We think in a validity area the UE does not need to notify network where the UE is, UE just sends SRS among cells, and LMF can notify all the gNBs within the validity area to monitor the SRS simultaneously. |
| Huawei, HiSilicon | No | A common SRS can be used by the UE within the validity area. The SRS is configured/activated by the network, and the network knows when the UE will perform SRS transmissions, which is controlled by the area-specific TAT. The network only needs to monitor the SRS transmission when it knows the UE is transmitting the SRS  |
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**Summary:**

# 4 Preconfigured SRSs (with/without validity area)

From the rapporteur’s perspective, the “preconfigured SRS” concept used in the previous discussions refer to the preconfigured common SRSs. For example, the network broadcast a list of positioning SRSs, all the UEs which camp on the cell can receive these SRSs. When the positioning event is detected, the UE will coordinate with the network to choose a SRS within the broadcast SRSs for this positioning.

## 4.1 Activation indication and/or request for preconfigured SRS

With the mechanism of network preconfigured common SRSs to UE, e.g. via posSIB, all the UEs camp on the cell can receive these SRS configurations. To avoid the conflict caused by two or more UEs which choose the same SRS at the same time, coordination between UE and RAN is needed. In RAN2#122, the following agreement was achieved.

Agreement:

RAN2 will introduce an activation indication and/or request for preconfigured SRS using at least Msg3/MsgA; FFS if Msg1 would be supported also. FFS RRC signalling or MAC CE for the Msg3/MsgA case, as for the configuration request. This agreement does not imply that the UE will be allowed to transmit autonomously.

Companies are invited to further discuss the detailed solution on how to send the activation indication and/or request for preconfigured common SRSs using Msg3/MsgA.

**Q4: For the mechanism of preconfigured SRSs, do you agree the preconfigured SRSs mean the preconfigured common SRSs?**

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| **Company** | **Yes/No** | **Comments** |
| Samsung | No. | The motivation of having pre-configured SRS is to reduce UE’s wake up duration for receiving SRS configuration in RRC\_INACTIVE state. For that, UE-specific SRS configuration can be delivered to UE via dedicated signalling (e.g., RRCRelease or RRCReconfiguration) before UE goes to RRC\_INACTIVE state. There is no clear motivation that the pre-configuration should be common to all UEs within cell/validity area. Also for the pre-configured common SRS, it is assumed that multiple common SRS resource(set)s will be broadcasted via (pos)SIB. In that case, to prevent SRS resource collision between UEs, every time one of the SRS resource(set)s is activated for a certain UE, it should be deleted from (pos)SIB. This makes UEs consume more power to receive the updated SIB. Thus, we think the pre-configuration should be UE-specific. |
| OPPO | No | Agree with Samsung. In addition, how to set the spatial relation of the SRS for positioning configuration is another problem. |
| vivo | No | Agree with SS that pre-configuration should be send to UE by dedicated signalling rather than broadcast as common SRS configuration.For common SRSs in posSIB, once one of the pre-configurations is successfully completed by a target UE, the posSIB should be updated, which will lead to frequent SI acquisition and more power consumption.Besides, the title of section 4 should be refined. According to WID, pre-configured SRSs are also associated with validity area:* For UL and DL+UL positioning for UEs in RRC\_INACTIVE state, specify SRS configuration enhancements based on SRS positioning validity area to avoid frequent RRC connection for SRS (re)configuration [RAN2, RAN1, RAN3].
	+ SRS for positioning configurations in multiple cells [RAN2, RAN1].
		- Note: Details including issues such as interference, timing advance, spatial relation information, pathloss reference and common SRS parameters across multiple cells can be further discussed during normative work.
	+ Pre-configuration of one or multiple SRS for positioning configurations [RAN2, RAN3].
	+ SRS for positioning activation/request procedure(s) [RAN2, RAN1].
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| Xiaomi | See comments  | If the preconfigured common SRS means all UE use the same SRS configuration, we think it is not feasible. If the preconfigured common SRS means the multiple preconfigured SRS are broadcasted by the Pos SIB, it could be considered. |
| ZTE | No | We understand that the pre-configured SRS means dedicated RRC signaling containing multiple pre-configured SRS for a UE, it is introduced in order to reduce the times that UE moves from RRC INACTIVE to RRC CONNECTED.If the SRS is common via SIB, UE and NW has to do the hand-shake to avoid SRS collision. This is not power saving from LPHAP UE perspective |
| Huawei, HiSilicon  | No | From our understanding, preconfigured SRS means an SRS configuration can be sent to the UE in advance, e.g. before a positioning session. Then the UE can send activation request to the receiving gNB when an event is detected, and the receiving gNB can directly activate the SRS by only updating the TA information without LMF involvement, which reduces latency and saves signalling overhead. We think the preconfigured SRS can be delivered to UE via dedicated signalling or via system information.  |
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**Q5: For the mechanism of preconfigured SRSs, please provide your view on which message is used for UE to send the activation indication and/or request for preconfigured SRS using Msg3/MsgA.**

* **Alt1: RRCResumeRequest**
* **Alt2: new RRC message**
* **Other**

**Which following signalling method of sending the activation indication and/or request for preconfigured SRSs do you support?** **Please also provide the detailed content/information of activation indication and/or request for preconfigured SRS in the comments column.**

* **Option A: In the RRC message, e.g. define a new resume cause in *RRCResumeRequest***
* **Option B: Accompanying MAC CE.**

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| **Company** | **Supported message****(Alt1/Alt2/other)** | **Signalling method****(Option A/B)** | **Comments** |
| Samsung | Alt1 | Option A | From our understanding, semi-persistent SRS configured in RRCRelease message can be regarded as the pre-configured SRS. When the UE needs to activate any SRS resource set for positioning, it can just request the activation of pre-configured SRS and the serving gNB can activate one of the pre-configured SRS resource sets. Thus, we think that 1 bit indication is enough for the activation request and one spare bit in ResumeCause can be used for that.(FFS. on whether we can have one common cause value for both ‘SRS configuration request’ and ‘pre-configured SRS activation request’.) |
| OPPO | Alt1 | Option A | Preconfigured SRS should be dedicated to one UE and 1 bit indication for activation is enough |
| vivo | Alt1 | Option A | We prefer to use the unified mechanism for SRS (pre-)configuration request and SRS pre-configuration activation indication to achieve a simpler design. That is, RRCResumeRequest with the same resume cause will apply for both SRS (pre-)configuration request and SRS activation indication. To achieve this, the SRS pre-configuration should be UE-specific and configured by dedicated RRC message. Regarding the specific procedure of the unified method, **-Step 1**: If UE wants to send SRS (pre-)configuration request or SRS activation indication, UE will initiate the RRCResumeRequest with the same resume cause.**-Step 2:** the resume gNB obtains UE context, if the resume cell is within the validity area, gNB will know the RRCResumeRequest initiated by UE is for SRS activation indication. If the resume cell isn’t within the validity area, the gNB can reconfigure a new SRS (pre-)configuration with validity area. If theresume gNB can’t obtain UE context, the UE will receive RRCSetup message and enter RRC-CONNECTED state, and the positioning fails. |
| Xiaomi | Alt 1 | See comment | One cell may associated with multiple preconfigured SRS, so the RRC resume request message carrying preconfigured SRS ID can be considered. |
| ZTE  | Alt 1 or Alt 2 | Option A | If the pre-configured SRS is associated with the cell identity (e.g., validity area), the SRS activation request can only contain the information that “I want to transmit SRS according to the SRS-cell association”. so UE can reuse the RRCResumeRequest with a new cause, 1 bit;If the pre-configured SRS is not associated with the cell identity, the SRS activation request should contain the information that “I want to transmit SRS according to the SRS-cell association” and ‘which SRS do I want to transmit’. in this case the legacy RRCResumeRequest can not be extended to contain SRS ID, so a new UL RRC message can be introduced.Furthermore, we agree with vivo that the two feature should be unified as one, i.e., only one additional resume cause in RRCResumeRequest can be applied to both SRS configuration request, and SRS activation request. |
| Huawei, HiSilicon | Alt 1 | Option A with comments | SRS configuration request message can be reused for activation of preconfigured SRS, i.e. no need to introduce a separate new cause for activation request.  |
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**Summary:**

Companies are invited to further discuss whether Msg1 would be supported to send the activation indication and/or request for preconfigured common SRSs.

**Q6: For the mechanism of preconfigured SRSs, do you support UE sending the activation indication and/or requesting for preconfigured SRS using Msg1? If yes, please also provide the detailed solution.**

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| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | When RRC signalling is used for the activation request, the UE should transmit MSG3 (RRCResume message) and receive the following activation command MAC CE from the gNB. However, the request/confirm procedure can be simplified using Msg1-based activation request. For example, when there is only one pre-configured SRS resource set within a certain cell/validity area, the UE can request activation of the SRS resource set by using the dedicated PRACH resource (e.g., dedicated preamble) for the UE and the activation can be confirmed by Msg2 (RAR) from gNB. Meanwhile, if there are multiple pre-configured SRS resource sets, the UE can request activation of a certain SRS resource set by using the dedicated PRACH resource associated with the target SRS resource set and the activation can be confirmed by Msg2 (RAR) from gNB. |
| OPPO | No. | Msg3 is enough. In the case of using dedicated preamble/RO, if the UE does not request activation of the SRS resource for long time, the RACH resource is wasted. |
| vivo | No  | Considering that the msg1 resource is limited, no need to have another solution to support activation indication. |
| Xiaomi | No | We are not clear about the advantages of MSG 1 compared to the MSG3 solution.  |
| ZTE | No | If the SRS activation request is via Msg1 preamble, gNB needs to know the UE identity. So the Msg1 preamble should be UE specific dedicate preamble.The problem is that there may not be enough dedicate preamble resources if the cell owns plenty of LPHAP UEs. And the dedicate preamble of the UE should be reserved by all the neighbor gNBs. Furthermore, if the dedicate preamble should further associated with SRS ID, that will make the preamble resource even more scarce. |
| Huawei, HiSilicon | No | See Q5, SRS configuration request message can be reused, so there is no need to introduce a Msg1, e.g. dedicated preamble.  |
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**Summary:**

# 5 Conclusion

Based on company feedback, the following is observed and proposed:

TBD

# 6 References

1. 3GPP TS 38.331 Radio Resource Control (RRC) protocol specification (Release 17).
2. 3GPP TS 38.305 Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN
3. RAN2#121-bis Chair note.
4. RAN2#122 Chair note.

# 7 Participants

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| --- | --- |
| **Company Name** | **Participant name/contact** |
| Samsung | Taeseop Lee/taeseop.lee@samsung.com |
| OPPO | liuyangbj@oppo.com |
| Xiaomi | lixiaolong1@xiaomi.com |
| ZTE | pan.yu24@zte.com.cn |
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